Feasibility Study of Home Care Wound Management Using Telemedicine

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ABSTRACT

OBJECTIVE: Evaluate the effectiveness of telemedicine (TM) with digital cameras in treating wounds in a home care setting.
DESIGN: Randomized controlled study.
PARTICIPANTS AND SETTING: One hundred three subjects with 160 pressure ulcers (PrUs) or nonhealing surgical wounds referred to a metropolitan Visiting Nurse Agency.
INTERVENTIONS: Subjects were randomly assigned to 1 of 3 groups. Group A (n = 40): weekly visits with TM and wound care specialist (WCS) consults; group B (n = 28): weekly visits with weekly consults with WCSs; and group C (n = 35): usual and customary care.
MAIN OUTCOME MEASURES: Outcome measures were time to heal, costs, length of stay (LOS), nursing visits, wound status, and change in size.
RESULTS: There was a similar distribution of subject characteristics in all 3 groups, but group A had disproportionally larger and more numerous PrUs and larger nonhealing surgical wounds. Group A had increased time to heal, LOS, costs, and visits compared with groups B and C; wound status was similar in all groups.
CONCLUSIONS: Uneven distribution of severity and type of wounds among groups, with greatest percentage of large wounds in TM group. Larger wounds consume more resources. TM is a useful communication tool in wound management but with limited power when randomization does not include wound size or type. Two important benchmarks were established for home care. First, it took 51 days, on average, to heal or improve PrUs and 34 days to heal or improve surgical wounds regardless of group. Second, nearly 90% of wounds improved or healed.

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INTRODUCTION

The treatment of wounds in this country remains a significant healthcare problem. In 1998, it was estimated that there were 5 million patients with wounds that cost approximately $20 billion to treat.[1] As expensive as this is, however, the cost to care for wounds is increasing at a rate of 10% per year.[1] Because a large part of these expenditures is due to hospitalizations and surgeries, there has been a growing effort to shift the site of wound care treatment to the home where costs are less than in healthcare facilities.

This shift has placed a disproportionate burden on home care agencies. For example, in fiscal year 2008, approximately 10% of admissions or 1500 patients treated by 1 large nonprofit home care agency had wounds requiring nursing intervention.[2] With the advent of the Prospective Payment System (PPS) in October 2000, home care agencies had increased incentive to examine the treatment of patients with wounds. Under PPS, home care agencies are reimbursed based on 80 categories or home health resource groups for each 60-day episode of care according to each patient's case mix (clinical, functional, and service utilization), which is determined on admission.[3] Services requiring extensive home visits are viewed as financial losers, so agencies are looking for ways to decrease visits while still achieving quality outcomes.

Three of the adverse events of the national quality initiative established by the Centers for Medicare and Medicaid Services (CMS) have also focused on wound outcomes. These events are (1) emergent care for deteriorating wounds, (2) discharged to the community needing wound care, and (3) an increase in pressure ulcers (PrUs) at discharge from home care. Quality outcomes will have even greater financial implications as Pay for Performance is proposed for home care agencies in 2011.

With increasing pressure to decrease home care visits while still ensuring positive quality outcomes, this home care agency decided to assess the effectiveness of using telemedicine in the

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treatment of wounds. Currently, in this agency, the home care nurses responsible for patient care are also primarily responsible for the treatment and management of wounds. If they want assistance with complicated or nonhealing wounds, they consult one of the agency's wound care specialists (WCSs) on staff. Because there is no formal protocol or ''threshold'' for referral to a WCS, practice varies among the nurses regarding the timing and urgency of when they request a consult. Subsequent to the study, the wound care specialists, through a surveillance program, identified wounds based on type, healing status, and stage of wound at admission to home care. This assured more proactive collaboration with the nursing staff on assessment and treatments.

When there is concern about the progress of wound healing, a verbal or written description is not always optimal for ''visualizing'' the wound and appreciating the subtleties of its status. Although a home visit by the WCSs may be desirable, it is not always feasible with only 2 WCSs to provide consultations. Other agencies have solved a similar shortage of WCSs by using TM in the form of videophones or digital cameras to provide images of the wounds to the specialist who can provide consultation outside the home.

A number of articles describe the potential usefulness of TM to treat wounds in the home.[4–7] Only a few, however, report any outcome data. Vesmarovich et al[6] used videophones to carry out a wound management program that successfully treated 7 of 12 Stages III and IV PrUs in the home. Kobza and Scheurich[8] examined the use of videophones for WCSs' consultations to the home care nurse during the actual home visit. Their results showed a decrease of 12% in hospital readmissions for wound-related reasons, a decrease in the average time to heal wounds, and a 45% decrease in the average number of nursing visits.[8] However, the absence of a control group makes it difficult to interpret their data when comparing their TM group with their baseline group. Also, this study was conducted during the initial period of tremendous decline nationally in home care visits per episode due to changes in reimbursement. During PPS implementation, the average number of visits each home health recipient received declined from 73 in 1997 to 41 in 1999 to 19 in 2003.[9,10] It is therefore possible that the 45% decrease in the average number of nursing visits could be a reflection of this national trend and not solely the TM.

Although these studies suggested the usefulness of having access via TM to a WCS on a regular basis, the absence of a concurrent or randomized control group makes it difficult to attribute the outcomes to TM alone. The purpose of this article was to describe a randomized controlled study designed to address this issue and to explore the potential value of TM in the management of wounds in a home care agency.

METHODS

Study Design

This study was conducted in a home care agency that is part of a large, freestanding, not-for-profit healthcare system. The southern part of this system is composed of 2 counties in the state of Maryland, all of the District of Columbia (DC), and counties in the Northern Virginia area that border DC and Maryland. This area is further divided into 12 geographic units with comparable population densities. Each geographic unit is assigned 1 home care nurse as part of a team of healthcare professionals who treat all patients living in that area. The 12 home care nurses, 1 for each of the 12 geographic units, were randomly assigned to 1 of 3 study groups with 4 nurses per group. These groups were designated as group A (TM), group B (non-TM), and group C (control). Study subjects were assigned to 1 of these 3 study groups based on the study nurse who served the area in which they lived. This ensured a random and equal (or nearly equal) distribution of subjects—but not wound types, which was impractical—into each of these 3 study groups.

In addition, to control for the nurses by level of wound expertise, the authors randomly assigned 2 nurses with high expertise and 2 with low expertise to each group. The level of wound expertise was based on the number of years treating wounds, performance in a wound care management course and examination, and quantitative assessment during an on-site wound competency evaluation.

At the time of the study, the agency was transitioning to laptop computers for all nurses to create an electronic record. Study nurses were able to enter all assessment data at each home visit into a laptop computer, including digital images for those subjects in group A. The assessment data, but not the digital images, became part of the permanent electronic medical record (McKesson Pathways; McKesson Corp, San Francisco, California). All data stored in the computers were password protected and encrypted for electronic transmission to ensure patient confidentiality and Health Insurance Portability and Accountability Act security.

Potential subjects were identified sequentially at the time of admission to the agency. Inclusion criteria were living in the healthcare system's catchment area, presence of 1 or more of 3 types of wounds (nonhealing surgical wound, PrU, stasis ulcer), and willingness to participate in the study. Exclusion criteria were the presence of partially or fully granulating surgical wounds; Stage I PrUs, burns, and diabetic wounds; life expectancy of less than 6 months; and being younger than 18 years. The agency's institutional review board approved the research protocol, and all subjects or their proxy gave written informed consent.

Wound Assessments and Interventions by Group

All wounds of each study subject in all 3 groups were evaluated and treated at least once weekly according to agency policy. In addition, standardized weekly wound assessment forms were completed for all subjects. Individuals in group A had their wounds further assessed using TM. This involved the study nurses taking digital images of the wounds and forwarding them electronically to the WCSs as part of a weekly consultation, either in person or by phone. Subjects in group B followed the same procedures as those in group A but did not receive the intervention of TM. Finally, subjects in group C had their wounds clinically assessed each week per agency policy but had no TM and no consults with the WCSs unless specifically requested by the study nurse.

Telemedicine Equipment, Training, and Protocol

Each study nurse in group A was provided with a Nikon Coolpix 4500 digital camera, a Fujitsu B series laptop computer, and a tripod. A minimum of 3 classroom training sessions of 2 to 3 hours each were conducted for groups A and B nurses to orient them to the study, to learn how to use the TM equipment under a variety of environmental conditions, and to maximize effective communication between themselves and the WCSs during the weekly consultations. These sessions were supplemented by one-on-one, in-home training with a WCS monitoring the nurses' clinical assessment skills and a rehabilitation engineer evaluating the technical issues of adequate lighting and effective picture taking. Group C nurses were oriented to the study, reiterating that they would be providing usual and customary care and could request a consultation with the WCS at any time, as is currently the agency procedure.

Group A nurses followed a standard TM protocol during each home visit. A typical series of required photographs for this group included 6 views: a distant image of the subject indicating the location of the wound; a mid-range shot to identify any abnormalities in the tissues surrounding the wound (eg, erythema); a close-up view; a minimum of 2 oblique images to identify any undermining, tunneling, and so on; and any additional views that the nurse felt were required to adequately depict the wound for the WCS. At least 1 of the images included the removed dressing to show any wound drainage. Paper tape and cotton swabs were used to measure the length, width, and depth of each wound and the extent of undermining, tunneling, and so on.

The subjects were instructed to look away from the camera for all images that might reveal their faces. Any additional identifiable features (eg, tattoo) were covered or not included in the photographs. The images (Nikon view) were downloaded to the laptop for review by the nurse before being electronically stored in the digital image capture card. Lighting for each photograph was standardized using the camera's flash attachment that was automatically modulated by the built-in light meter.

Outcome Variables

The central question investigated in this study was which of the 3 groups provided the most effective wound care. The primary outcome variable was time to heal. Secondary outcome variables included number of nursing visits, length of stay (LOS), change in size, wound status, and costs. LOS was limited to the number of days wounds were treated by the agency during the study. Costs included the number of visits by registered nurses (RNs) and licensed practical nurses (LPNs), telephone and in-home consults by the WCSs, and supplies/products used.

Data Preparation and Statistical Analysis

Data were extracted and stored in a password-protected Microsoft Excel database and analyzed using SPSS version 12. Depending on the nature of the study variables, the authors used chi-square statistics and Kruskal-Wallis (nonparametric analysis) to compare the differences of sample characteristics, resources used, and wound outcomes across the 3 groups. This allowed the authors to analyze data without assuming an underlying distribution. In particular, Kruskal-Wallis tests allowed the authors to analyze the ranks of variables with continuous distributions rather than the original values. Descriptive and comparative results, such as percentages, means, and SDs, are presented in each table. Study findings with $P \leq .05$ are considered statistically significant.

Sample Size

The sample size was calculated using nQuery Advisor 5 statistical software (Statistical Solutions, Saugas, Massachusetts). To attain statistical significance ($P = .05$ at a power of 99%), the authors required a sample size of 48 wounds per group to show .755 probability that time to heal (ie, the primary outcome variable) in group A was less than that in groups B and C using a Wilcoxon rank sum test with a 2-sided significance level of .025.

RESULTS

The authors collected data over a period of 16 months on nonhealing surgical wounds, PrUs, and stasis ulcers. During this time, 123 subjects met the inclusion criteria and were enrolled in the study. However, of these 123 individuals, 20 were not included in the final analyses for the following reasons: 6 did not meet all of the inclusion criteria, 3 moved from the area, and 3 were not seen by the visiting nurse after agreeing to participate. There were only 8 subjects who had stasis ulcers, which was an insufficient number for a meaningful analysis. Among the 20

subjects dropped from the study, 9 had been enrolled in group B, 7 were from group C, and 4 were from group A. This left a total of 103 subjects who had 160 wounds suitable for analysis.

Table 1 summarizes subject characteristics by group. The mean age was less than 59 years for all groups, indicating a relatively young population for home care. Most of the study subjects were female, and the self-reported racial breakdown was 66% black, 23% white, and 11% other. There were no significant differences in age, sex, race, Braden score, and activities of daily living (ADL) score at admission across the 3 groups.

The Braden score ranges from 0 to 23, with a score of 12 or less indicating a high risk for developing a wound. The mean Braden score for each group was greater than 18, indicating, on average, a low-risk status for each group. Using the Outcome Assessment Information Set instrument, the total ADL score varies from 0 to 41 based on 8 common daily activities. The total ADL score had an overall mean of 9.4 and a range among the groups of 8.2 to 10.3, indicating that the overall functional level of the study subjects was high as measured.

A slight majority (52%) of the subjects were Medicare beneficiaries, with a high of 64% in group B and a low of 40% in group C. Medicaid beneficiaries and managed-care enrollees accounted for the other 2 major payment sources. The insurance differences by group were not statistically significant.

As seen in Table 2, two-thirds or 107 of the wounds were nonhealing surgical wounds. This high number of nonhealing surgical wounds is typical for this home care agency that is part of a healthcare system and receives the majority of its referrals from hospitals. Thirty-four percent or 56 of the wounds were PrUs, with 57% of these ulcers being Stage III or Stage IV. There was a large difference in the number of Stages III and IV PrUs by group: group A had 19, B had 9, and C had 4. There was also a large difference in the initial wound size by group for Stages III and IV ulcers. In analyzing all PrUs, group A had significantly larger pressure wounds than the other 2 groups (P = .031). By contrast, the initial size of the surgical wounds showed no significant difference by group.

There were approximately 1.6 wounds per study subject; some subjects had only 1 wound, whereas others had 2 or more wounds. The measures used for calculating wound care resources were by subject rather than by wound(s) because of the difficulty in separating costs of supplies and visits by individual wounds. As Table 3 illustrates, the study subjects in group A had, on average, a longer LOS, although this was not statistically significantly different from groups B and C. However, the number of RN/LPN visits per study subject was significantly different, with group A having 27 visits compared with 13 for group B and 18 for group C (P = .043). Visit intensity was also statistically significant, with group A having more visits than groups B and C (P = .021).

Table 1.

SUBJECT CHARACTERISTICS BY GROUP

	Groups			
	Totals n = 103 Mean (SD)	A n = 40 Mean (SD)	B n = 28 Mean (SD)	C n = 35 Mean (SD)
Age, y	58.0 (17.1)	58.4 (18.2)	58.2 (17.7)	57.5 (15.9)
Braden score[a]	18.5 (3.3)	18.5 (3.5)	18.3 (3.0)	18.7 (3.4)
Total ADL score[b]	9.4 (7.9)	8.2 (7.6)	10.1 (9.3)	10.3 (7.1)
	n (%)	n (%)	n (%)	n (%)
Sex: Female	71 (69)	26 (65)	20 (71)	25 (71)
Race				
White	24 (23)	8 (20)	7 (25)	9 (26)
Black	68 (66)	29 (73)	21 (75)	18 (51)
Other	11 (11)	3 (8)	—	8 (23)

[a]Braden score: 0 to 23. See text for explanation.

[b]Total ADL score: 0 to 41. See text for explanation.

Table 2.

WOUND TYPE AND INITIAL SIZE OF WOUNDS BY GROUP

	Groups			
	Totals n = 163	A n = 62	B n = 49	C n = 52
Type of wound				
Surgical	107 (66)	33 (53)	31 (63)	43 (83)
PrU	56 (34)	29 (47)	18 (37)	9 (17)
Stages III and IV	32 (57)	19 (66)	9 (50)	4 (44)
Initial mean wound size, cm^3				
Surgical	166.3	262.3	75.5	153.8
PrU	42.7	62.3	11.2	45.1
Stages III and IV	60.7	88.6	20.0	19.6

Table 3.

MEAN WOUND CARE RESOURCE USE BY STUDY GROUP

	Groups			
Resources	Totals n = 103	A n = 40	B n = 28	C n = 35s
(1) Mean length of stay in study, days	43	51	36	40
(2) Mean number of RN/LPN visits/patient	20	27	13	18
(3) Mean visit intensity/patient[a]	0.46	0.53	0.35	0.44
(4) Mean total cost/patient, $	2970.13	4021.84	1937.01	2595.68
RN/LPN visits	2796.47	3797.81	1778.00	2466.85
WCS phone consults	30.46	46.79	45.20	0.00
WCS home consults	37.29	56.90	15.24	32.51
Supplies[b]	105.92	120.35	98.57	96.32

Abbreviations: RN = visiting nurse; LPN = licensed practical nurse; WCS = wound care specialist.

[a]Visit intensity = registered nurse/licensed practical nurse/wound care specialist visits or consults/length of stay.

[b]Supplies are wound care dressings and advanced wound care products.

Visit intensity was defined as all nursing visits—RN + LPN + WCS (WCS home visit consultations)—during the time the subject was in the study divided by the LOS in the study. Finally, the total costs per subject were significantly greater for group A subjects than subjects in the other 2 groups. These costs included RN/LPN visits, WCS phone consults, WCS home consults, and supplies.

Row A of Table 4 summarizes data for wound outcomes in 4 categories: deteriorated, no change, improved but not healed, and healed. The authors measured length x width x depth for each wound at baseline, ie, on admission or when first identified and at the time of discharge or when it was healed. This was done so the authors would have baseline measurements compared to subsequent measurements to see change over time. The authors defined each one of the 4 categories. For example, improved is defined as follows: ''Since entering study: ''Wound size (length, width, depth, tunneling, or undermining) has decreased. Necrotic tissue has decreased and granulation has increased with or without decrease in drainage.'' A large majority of the wounds, close to 90%, fell into either the improved or healed category in all 3 groups. More than one-third of the wounds in group B were completely healed, and more than two-thirds of the wounds in groups A and C were improved.

Row B of Table 4 displays the information on days to heal. For both types of wounds evaluated, the average time to heal was longer for group A wounds than for those in groups B and C ($P = .008$). In addition, the average number of days for PrUs to improve or completely heal was significantly longer in group A than in groups B and C ($P = .022$).

Finally, row C of Table 4 outlines the changes in wound size (expressed in cubic centimeters) for both nonhealing surgical wounds and PrUs. The change in wound size for PrUs was significant for group A ($P = .039$). Indeed, the changes in group A wound sizes were nearly statistically significant for both types of wounds when compared with the changes in wound sizes found in groups B and C ($P = .052$).

Table 4.

WOUND OUTCOMES BY GROUP

	Groups			
	Totals n = 160 n (%)	A n = 62 n (%)	B n = 47 n (%)	C n = 51 n (%)
A. Wound outcomes				
Deteriorated	10 (6.2)	5 (8.0)	2 (4.3)	3 (5.9)
No change	8 (5.0)	4 (6.5)	1 (2.1)	3 (5.9)
Improved, not healed	110 (68.8)	46 (74.2)	27 (57.4)	37 (72.5)
Healed	32 (20.0)	7 (11.3)	17 (36.2)	8 (15.7)
B. Days to heal*				
Surgical wounds				
No. wounds	96	30	27	39
Days to heal (SD)	34 (22)	40 (25)	29 (15)	33 (23)
Pressure ulcers				
No. wounds	46	23	17	6
Days to heal (SD)	51 (36)	66 (39)	31 (21)	46 (33)
Total wounds				
No. wounds	142	53	44	45
Days to heal (SD)	39 (28)	51 (34)	30 (17)	35 (25)
C. Change in wound size[a]				
Surgical wounds				
No. wounds	96	30	27	39
Change in cm^3 (SD)	151 (464)	238 (765)	60 (103)	148 (271)
Pressure ulcers[b]				
No. wounds	45	22	17	6
Change in cm^3 (SD)	28 (100)	47 (142)	6 (10)	18 (18)
Total wounds				
No. wounds	141	52	44	45
Change in cm^3 (SD)	112 (391)	158 (592)	39 (85)	130 (256)

[a]Improved or healed wounds only.

[b]Follow-up measurement missing for 1 subject in Group A.

DISCUSSION

The purpose of this study was to investigate the effectiveness of TM on the outcomes of wound care in a home care setting. The results showed that wounds in the TM group (group A), in general, did not do as well as those in the 2 comparison groups. The primary reason for these findings was unrelated to the intervention of TM but rather to the disproportionate distribution, by chance, in group A of large nonhealing surgical wounds and large, numerous PrUs. Therefore, it is difficult to draw any definitive conclusions from these results about the effectiveness of teleassessment in treating nonhealing surgical wounds and PrUs—particularly full-thickness lesions—in home care. However, in the process of reviewing the authors' study methods and data, a number of important and useful insights became clear, including the relation of wound healing to the size and type of wound, the role of TM in wound management in the home, and the challenges of performing health services research in a home care setting.

Healing

''Days to heal,'' the primary outcome of interest in this study, was defined as wounds that improved or healed. Healed and improved categories were combined because many patients today are discharged from home care before complete wound healing. Using this definition, the authors found that all PrUs, on average, took 51 days to heal, whereas surgical wounds took 34 days. These data establish a reliable benchmark for days to heal for wounds for home care agencies to use because no other studies could be found with comparable data.

Another obvious but important finding is that large wounds use more resources. Group A had significantly higher costs per patient including the largest expense—home nursing visits. This was not surprising because group A had larger and deeper wounds in both categories of surgical and pressure wounds.

The WCSs' visits were also higher for group A than groups B and C, contrary to what was expected. The authors suspect that the large number of Stages III and IV PrUs in group A may have required the WCSs to make more frequent in-home consult visits for better visual assessment of the wound. A previous study supported this result and found that 33% of Stage III and 100% of Stage IV pressure wounds required a live examination as opposed to relying entirely on a camera image and the clinical data.[11] These observations suggest that current technology has definite limitations to the combination of clinical descriptions and sharp, high-quality images in assessing deep wounds. This may change with more experience and more sophisticated image-detection equipment. But for now, many will agree with one of the WCSs who said, ''Nothing beats being there.''

Although group A used more resources and the wounds took longer to heal than in groups B and C, interestingly, group A wounds had a significantly greater change in size for PrUs, and indeed for all wounds, than the other 2 groups. This finding suggests that the amount and type of resources used can result in a significant decrease in wound sizes. This measure of wound healing is most relevant for home care because patients can be discharged from home care before complete wound healing, either because the family or patient can assume the care or because third-party–payer insurance coverage limits the number of visits.

Because surgical wounds comprise the largest number of wounds for home care agencies, another important finding is that surgical wounds, on average, were 4 times larger than PrUs on admission, but they healed in one-third the time or, on average, 17 days faster than PrUs. This observation suggests the necessity of adequate attention and resources for the larger, deeper PrUs to ensure more rapid healing. It also raises the question of whether patients in the TM group (group A) with weekly consults and visual monitoring were subject to the Hawthorne effect, resulting in an increased desire on the part of these study nurses to be successful.

Finally, another significant finding regarding wound healing is the outcome that nearly 90% of wounds either improved or healed during the study. The authors believe that this establishes another benchmark for home care and suggests that the home with home care services may be the most appropriate setting to heal wounds.

The cost of healing or improving wounds in this study was, on average, $2970 across all study groups. With nearly 90% of all wounds either improved or healed, this overall amount may be an important figure in these fiscally constrained times. This figure is significantly less than wound care costs accrued in institutional settings and has far-reaching health policy implications.

TELEMEDICINE

Although digital cameras and videophones each have their advantages and limitations, the authors chose to use digital cameras based on the investigators' experience, the comparison of the resolution and quality of images obtained using the 2 technologies,[11] and the preference of the study nurses in the home care agency. The decision to use digital cameras was not based on any reports in the literature. To the authors' knowledge, no published studies have compared the quality and effectiveness of digital images with that of videophones. With the recent and rapidly accelerating advances in cell phone technology, this may become the image-transmission method of choice in the future.

The study staff (home care nurses and WCSs) underwent a formal training program to ensure proper use of the hardware such as cameras, laptops, computers, and so on. Although the researchers understood the importance of training the nursing staff in wound assessment, the authors gained a fresh appreciation of staff competency in the management of the TM technology. Clinical staff need to know how to handle the many variables in the home care setting, such as poor lighting, wounds that are in difficult locations, and each time consistently capturing the same view of the wound. They need to be experienced in how to solve problems if/when the camera malfunctions, as well as in the downloading of the pictures onto the laptop in the home. Development of competency in the use of the camera and the interface of the camera with the computer through a skills laboratory would need to be integrated into any wound care training for clinical staff in home care. In future studies, a more intensive training program would be desirable, focusing both on mastery of the technology and the home care nurse-WCS relationship. In addition, it would be important to incorporate recent advances in wound imaging technology to facilitate improved accuracy of TM decision making.[12,13] Rennert et al[13] described training to include: wound preparation, taking the photograph using proper technique, uploading and editing the photograph, and measuring the wound through software. For all new trainees, photographs are reviewed for a period of 2 weeks.[13] The WCSs' analyses are reliant on the information captured by the study nurse in the home, who is ultimately responsible for taking high-quality digital images and providing complete and accurate database information. This underscores an important conclusion of the study that was expressed by a number of the study staff, namely, that TM is an excellent communication and educational tool.

HEALTH RESEARCH TOOL

Although wound care provided in the home is less costly than in other healthcare settings, it is still very expensive. This is an observation strongly reinforced by the data collected in this study. If healthcare providers are ever going to decrease the physical, emotional, and financial burden of wound care in the home,

further research in this area is imperative. To be effective, however, it is important to acknowledge the barriers and challenges of conducting such research, especially by a single agency.

One barrier is research costs. This study was sponsored, in part, by outside funding, but the cost to the agency and individual study staff in contributed time and energy was substantial—especially for groups A and B. To compensate for this research ''burden,'' study nurses in these groups were assigned fewer patients, thus reducing their productivity. This reduction was particularly difficult for nurses paid per visit. These costs to agency and staff are a strong disincentive to conducting research at a time when most agencies are struggling to remain profitable.

In addition, there are challenges inherent in the nature of home care research itself. When doing home care research, many important, but unmeasured, variables are outside the control of the investigators. For example, each home is unique in terms of space, lighting, pets, furniture, and support personnel. Essentially, the nurse is a ''guest'' in the subject's home and must rely on the goodwill of patients and their families and friends to adhere to the wound care regimens prescribed by the physician. It is these families, friends, or paid caregivers that provide the assistance necessary to ensure adequate nutrition, position changes, and other physical aids required for successful healing. All of these factors influence the conduct of research in the home care setting.

CONCLUSION

Based on this study and the experiences reported in the literature, the authors believe that the proper role of TM in wound healing is still evolving. These findings did not demonstrate that TM was effective using this study design. With the unequal distribution of large and numerous PrUs in group A, it would be unrealistic to expect that a positive effect would emerge. Even if there had been an equal distribution of Stages III and IV PrUs in all 3 groups, the authors are not convinced that TM by itself would have made a significant difference. This is due in part to the complex nature of PrUs that makes each lesion a challenge to heal.

From this study, it is clear that large and deep surgical wounds do not pose the same difficulty in healing time and resource use as Stages III and IV PrUs. The dramatically shortened healing time for large surgical wounds is an important finding for home care agencies as surgical wounds represent the largest number of wounds treated by many home care agencies. Nationally, approximately 30% of all Medicare/Medicaid patients in home care have surgical wounds.[14] In this study, there were approximately twice as many surgical wounds as PrUs, yet they healed in a shorter time and used fewer resources. With fewer resources expended for the treatment of surgical wounds, home care agencies may not be as concerned with healing these wounds. However, with improvement in surgical wounds as one of the quality outcomes evaluated nationally through CMS's Outcome-Based Quality Improvement measure, it will continue to be an important focus for home care agencies.

The challenge of healing deep PrUs was amply confirmed in this study. When all available resources, including nursing visits, WCS consults and visits, costly supplies, and the use of digital cameras, were provided, these wounds improved dramatically as evidenced by the significant change in size of the group A PrUs compared with groups B and C. As with any complex and difficult-to-treat problem, multiple approaches may be the answer. For the healing of Stages III and IV PrUs, this may include several factors, such as the involvement of the clinical expertise of the WCS, through technology or on-site visiting, the use of advanced wound products, frequent communication with the physician, nursing staff trained in proper wound assessment and product use, ongoing teaching of the patient and family, and the continuous measurement of each patient's progress. The success of improving these wounds may also have resulted from the constant focus and monitoring this study brought to the problem of wound healing. In research, clinicians try to isolate a treatment so they can investigate it. Based on the results of this study, the authors conclude that TM, that is, using cameras for remote visualization, at its best, is one tool in an arsenal of approaches that can be used to successfully heal wounds in home care. ●

REFERENCES

1. Ablaza V, Fisher J. Telemedicine and wound care management. Home Care Provid 1998;3:206-11.
2. MedStar Health Visiting Nurse Association Annual Report: Fiscal Year 2008. Columbia, Maryland: MedStar Health; 2008.
3. Medicare program; prospective payment for home health agencies. Health Care Financing Administration: final rule (HCFA-1059-F). Fed Regist (2000).
4. Nakamura K, Takano T, Akao C. The effectiveness of videophones in home health care for the elderly. Med Care 1999;37:117-25.
5. Burns RB, Crislip D, Daviou P, et al. Using telehabilitation to support assistive technology. Assist Technol 1998;10:126-33.
6. Vesmarovich S, Walker T, Khauber R, Temkin A, Burns R. Use of telerehabilitation to manage PrUs in persons with spinal cord injuries. Adv Wound Care 1999;12:264-9.
7. Roth AC, Reid JC, Plunkett CL, Concannon MJ. Digital images in the diagnosis of wound healing problems. Plast Reconstr Surg 1999;103:483-6.
8. Kobza L, Scheurich A. The impact of telemedicine on outcomes of chronic wounds in the home care setting. Ostomy Wound Manage 2000;46(10):48-53.
9. Pear R. Medicare spending for care at home plunges by 45%. New York Times April 21, 2000:A1,A20.
10. Schorr B. RHHIs report their HHAs' average number of episodes, LUPAs, outliers for periods ended June 30. Home Health Line October 10, 2003:3-5.
11. Halstead LS, Dang T, Elrod M, Convit RJ, Rosen MJ, Woods S. Teleassessment compared with live assessment in a wound clinic: a pilot study. Adv Skin Wound Care 2002;16:91-6.
12. Ahn C, Salcido R. Advances in wound photography and assessment methods. Adv Skin Wound Care 2008;21:85-93.
13. Rennert R, Golinko M, Kaplan D, Flattau A, Brem H. Standardization of wound photography using the wound electronic medical record. Adv Skin Wound Care 2009;22:32-8.
14. Home care compare. 2004 [cited 2004 Oct 20]. http://www.Medicare.gov/hhcompare/Home.asp. Last accessed on June 12, 2009.